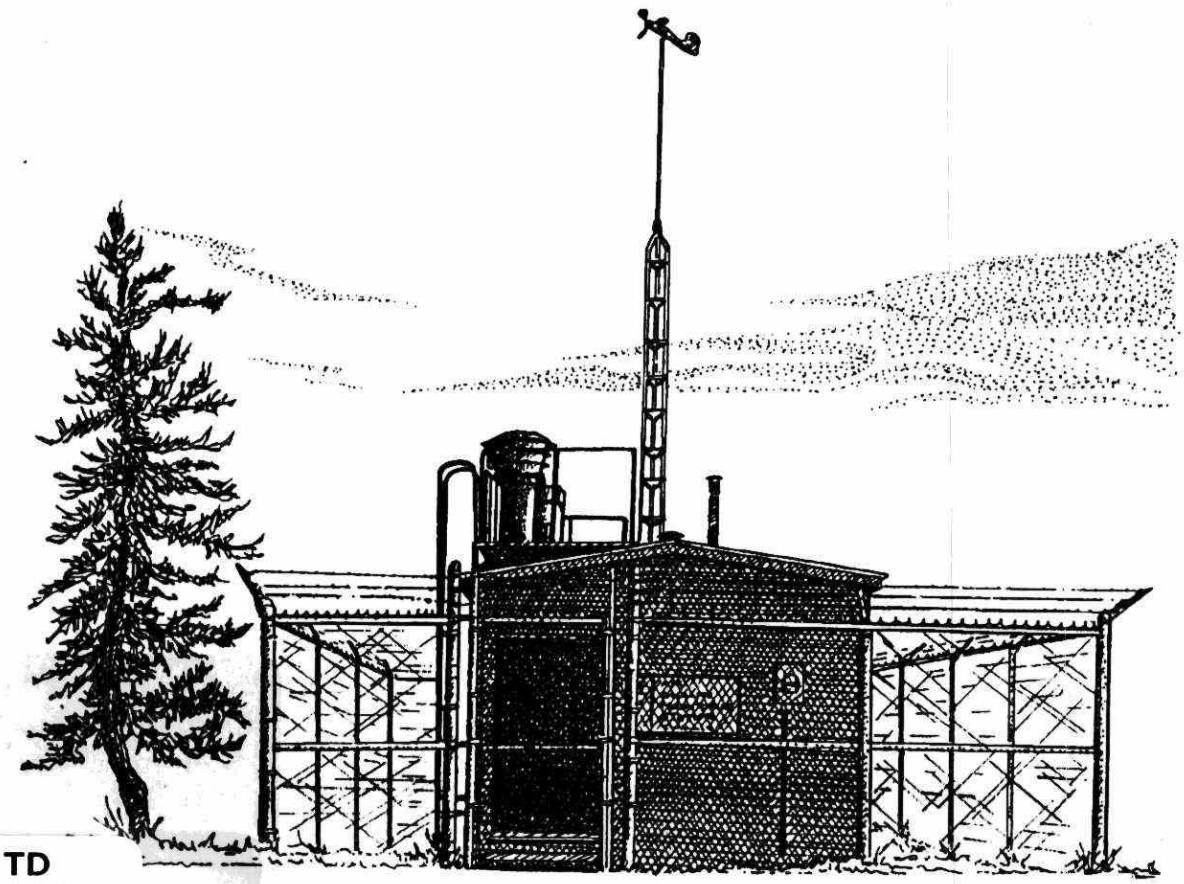
AIR QUALITY ASSESSMENT THUNDER BAY TERMINALS LIMITED THUNDER BAY, 1990

JUNE, 1990.



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AIR QUALITY ASSESSMENT

THUNDER BAY TERMINALS LIMITED,

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1990

Dennis Griffin
Chief, Air Quality Assessment

Don Racette
Environmental Scientist

TECHNICAL ASSESSMENT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT

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INTRODUCTION

Since 1978, Thunder Bay Terminals Limited has operated a bulk storage and trans-shipment facility adjacent to Thunder Bay harbour. Between 1978 and 1989, air quality assessment studies (including air quality monitoring, vegetation, soil and snow sampling) have shown that there has been no increase in dust levels off company property as a result of operations at the terminal. In 1990, the terminal processed nearly 4 million tonnes of bituminous coal and lignite, about 1 million tonnes of potash, and 150,000 tonnes of grain pellets.

AIR QUALITY DATA FOR 1990

DUSTFALL

In 1990, monthly dustfall was provided by Thunder Bay Terminals for sites 1,3,6 and 7, shown in Figure 1. Monitoring at two Ministry-operated sites off Thunder Bay Terminals property was discontinued at the end of 1989.

The 1990 dustfall results (Table 1) show that at the location off company property (site 1), monthly dustfall exceeded Ontario's maximum acceptable limit of 7 $g/m^2/30$ d (grams of total dustfall per square metre for 30 days) during 3 months. The annual dustfall objective (4.6 $g/m^2/30$ d) was also slightly exceeded at this site. At the three monitoring locations on Thunder Bay Terminals property, dustfall was above the monthly objective for 8 of 36 samples. The annual dustfall objective was slightly exceeded at all three sites.

Except for the March sample at site 6 on Thunder Bay Terminals property, all exceedances of the monthly dustfall objective in 1990 were caused by soluble material. This finding means that coal dust was not the cause of most of the elevated dustfall readings. The soluble material causing the high dustfall was not identified.

Average dustfall at the four monitoring sites in 1990 was somewhat higher than averages for recent years (Table 2). No trends have occurred over the past decade.

TOTAL SUSPENDED PARTICULATE MATTER (TSP)

Suspended particulate matter (TSP) comprises particles of small size which remain entrained in the air for long periods. It is more of a health-related contaminant than is dustfall. TSP at three locations was measured for a 24-hour period every sixth day during 1990, using a standard high-volume sampler. Table 3 shows that during the year, TSP met the annual objective (60 $\mu g/m^3$) at all monitoring sites. There were no exceedances of the daily objective (120 $\mu g/m^3$) either on or off company property. Average TSP at the three sites (Table 4) was similar to values recorded for many of the 13 preceding years; TSP levels showed no trend from 1976 to 1990.

SNOW SAMPLING SURVEY

Introduction

In response to complaints of black particulate matter on the snow southeast of McKellar Island, a snow sampling survey was conducted in February, 1990. This survey showed that windblown coal dust had been deposited on the lake surface for a distance of at least 1200 metres from Thunder Bay Terminals property. Later in 1990, the company began a dust control program to reduce particulate emissions from coal piles. To assess the effects of these controls, another snow survey was carried out in February, 1991.

Methods

The 1990 survey was repeated in 1991 using the same sampling sites, sampling and sample processing methods.[1] Snow collection sites are shown in Figure 2.

Determinations of aluminum, chloride, conductivity, iron, pH, potassium and residues were performed at the Ministry's Thunder Bay Laboratory. Carbon was analyzed at the Ministry's Toronto Laboratory.

The results of the survey are interpreted in relation to contaminant guidelines developed by the Ministry for snow. Values above guidelines exceed the upper limit of normal for northwestern Ontario, but health or environmental effects are not necessarily implied. Contaminant guidelines have no legal status in Ministry legislation, but serve as useful indicators of possible contaminant problems.

Results

Results of both the 1990 and 1991 surveys are presented in Table 5. The data show that average contaminant levels fell 70 to 80% from 1990 to 1991. In 1991, chloride and potassium did not exceed contaminant guidelines either on or off Thunder Bay Terminals property. Aluminum and iron exceeded guidelines at a few locations on company property, but not at any off-property sampling sites. Particulate carbon and solids were above guidelines at most places on Thunder Bay Terminals property. Off property, guideline exceedances occurred at six sites for carbon and at four sites for solids. However, in 1990, guidelines for both carbon and solids were exceeded at all 15 off-property sites. The improvement in 1991 is clearly seen in Figures 3a and 3b, which compare particulate carbon levels in 1990 and 1991. In 1991 there was no obvious zone of visible fallout from coal particles. Trace

to light amounts of black particulate matter were, however, seen on or below the snow surface at sampling sites 5, 6, 8, 13, 16, and 25, 26.

Concentrations of four parameters in snow are compared in Table 6 for years before the terminal was in operation (1975, 1976) and for years under normal operating conditions (1979, 1980, 1990 and 1991). The comparison reveals that while 1991 contaminant levels were usually higher than pre-operational levels, they were well below concentrations found under normal operating conditions in 1979, 1980 and 1990.

In late 1990, Thunder Bay Terminals put in place an abatement program designed to reduce dust emissions. The controls comprised water spray and snow-making machines to bind loose particles to the surface of the coal pile. Based on the results of our 1991 study, this action appears to have yielded successful results.

The 1991 sampling results, while encouraging, may not be conclusive. Part of the sharp decline in contaminant levels from 1990 to 1991 may have been due to loss of contaminants from the snow cover by leaching. Table 5 shows that, for 4 of the 6 parameters listed, there was a significant decline in concentrations in control samples as well as in samples near the coal piles. This loss may have occurred during thaws which occurred from time to time for a total of 75 hours prior to the 1991 sampling date. A maximum air temperature of 7°C was recorded on December 7, 1990, and on February 4, 1991.

CONCLUSIONS

Dustfall on and near Thunder Bay Terminals property complied with Ontario's monthly objective most of the time during 1990. Suspended particulate matter, of more interest than dustfall for

potential health impact, complied with Ontario objectives at all times, both on and off company property.

A snow sampling survey in early 1991 revealed a sharp decline in levels of coal dust blown onto Lake Superior. While abatement controls implemented by Thunder Bay Terminals are credited with this improvement, the data must be interpreted with caution. Thaw conditions may also have contributed to lower contaminant levels.

REFERENCE

1. Griffin, H. D. and D. J. Racette. 1990. Air quality assessment, Thunder Bay Terminals Limited, Thunder Bay, 1989. Ontario Ministry of the Environment.

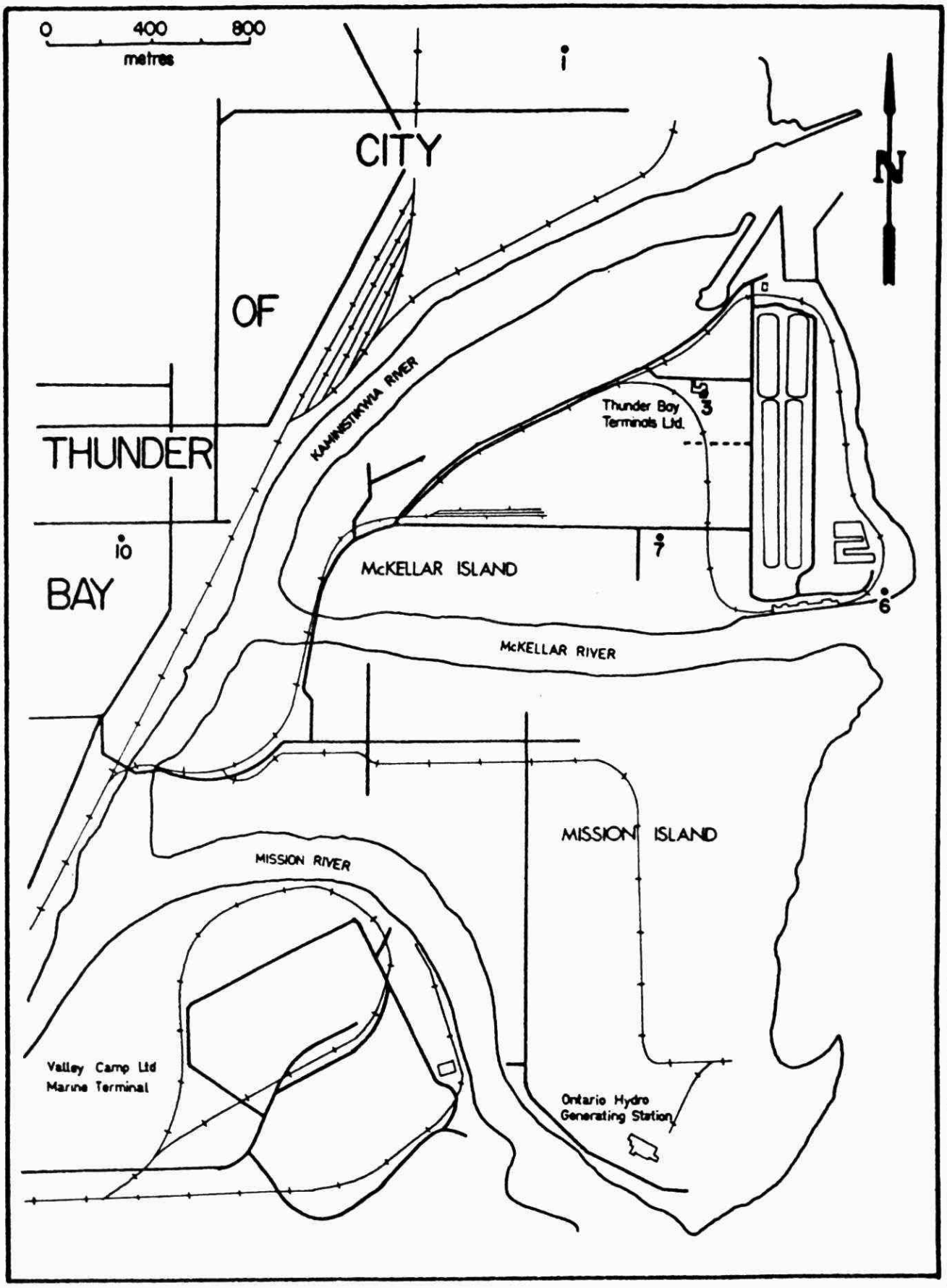

Figure 1. Air quality monitoring sites, Thunder Bay Terminals Limited.

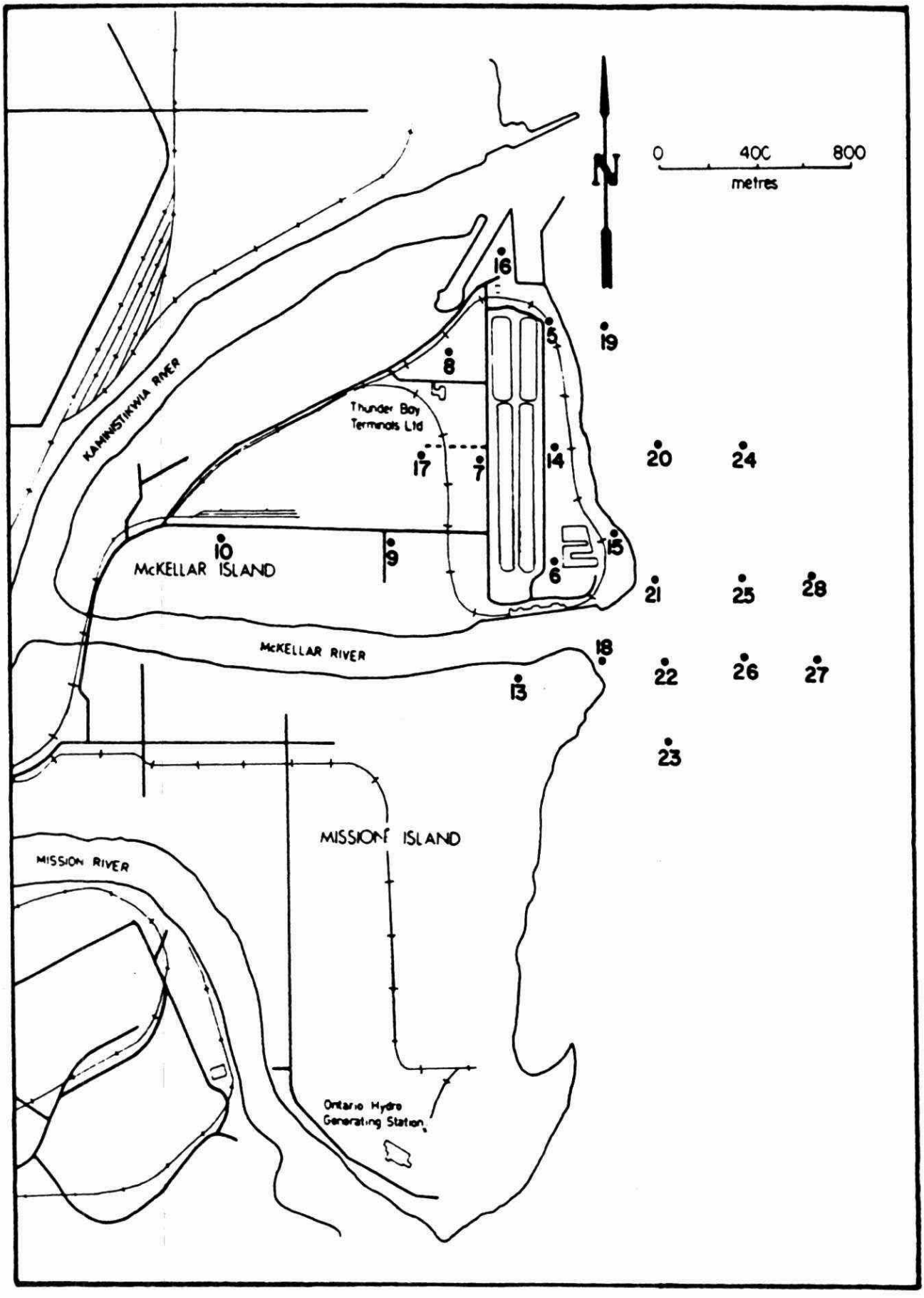

Figure 2. Snow sampling site, Thunder Bay Terminals Ltd., February 4-5, 1991.

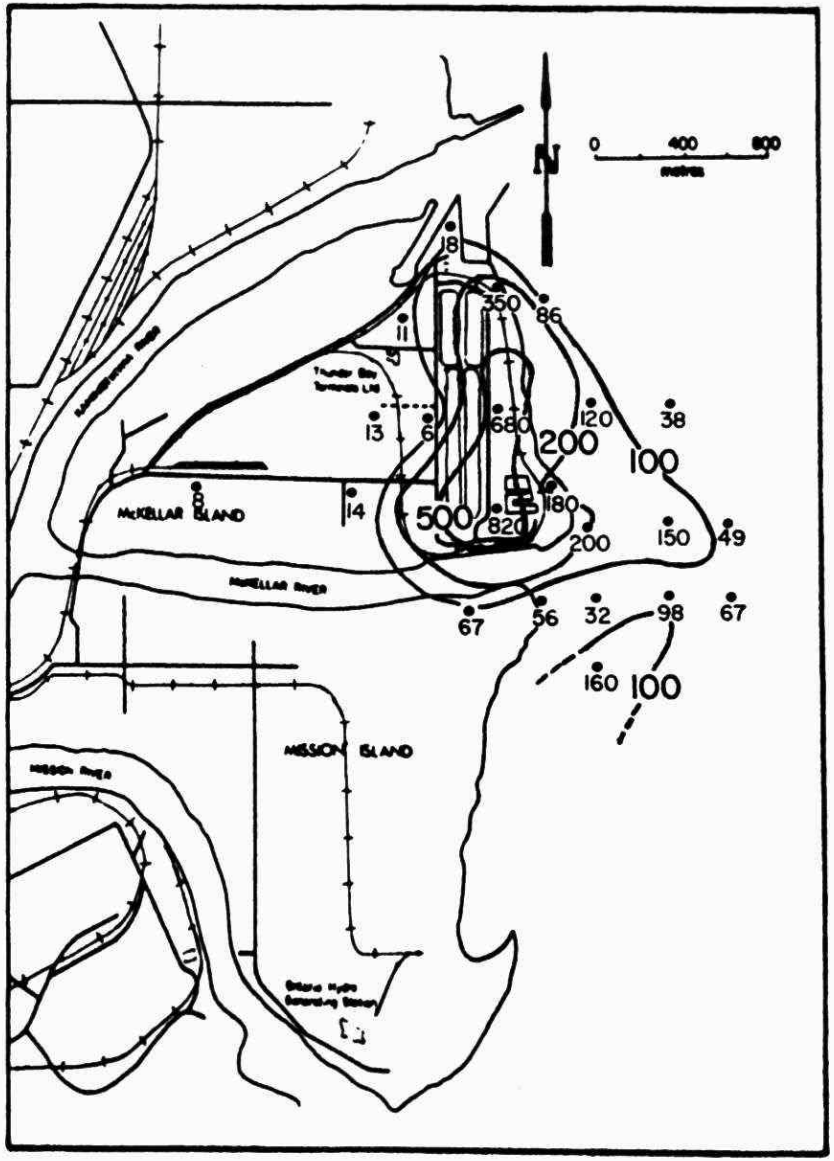

Figure 3a. Particulate carbon (mg/l) in snow near Thunder Bay Terminals Limited, February 13, 1990.

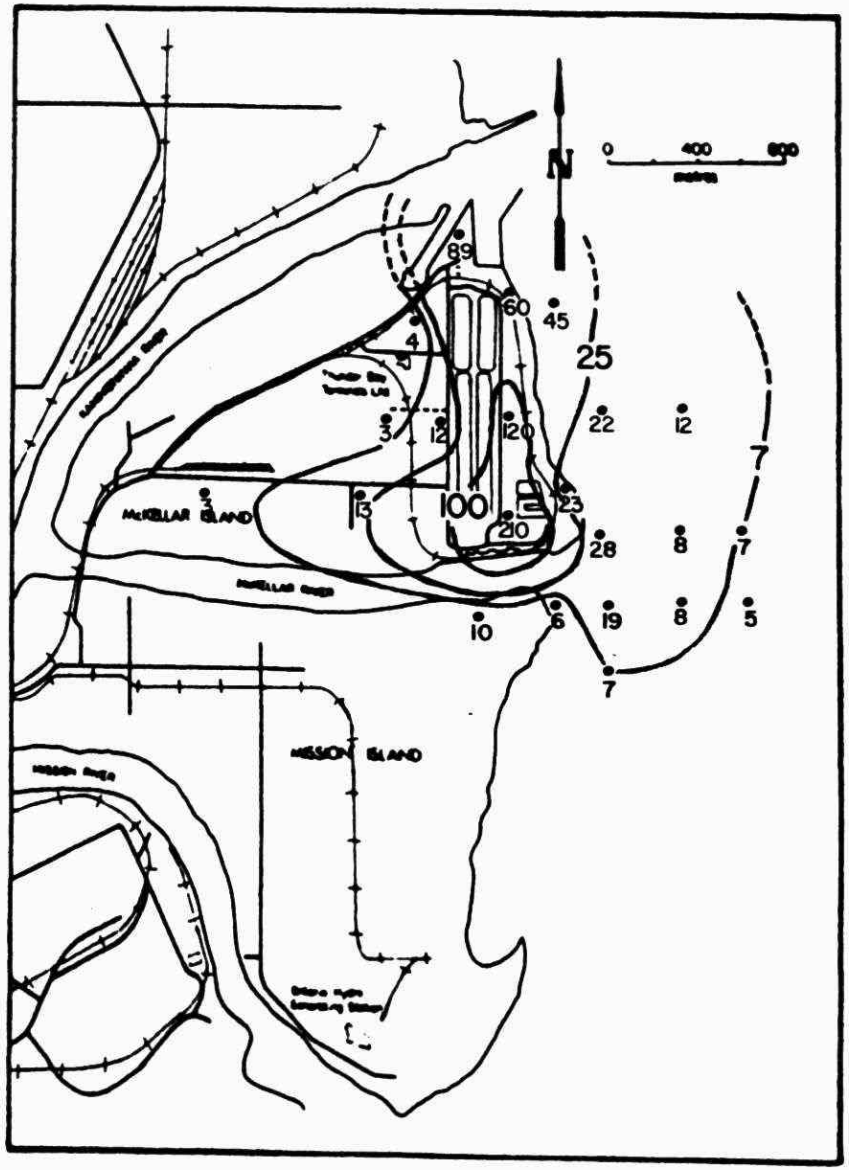

Figure 3b. Particulate carbon (mg/l) in snow near Thunder Bay Terminals Limited, February 4, 1991.

TABLE 1. Total dustfall (g/m^2/30 days) near Thunder Bay Terminals Limited, 1990.

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	Sewage Treatment Plant	0.8	1.9	5.1	18.5	2.4	3.1	4.0	3.2	8.6	9.6	1.5	1.4	5.0
3[a]	Thunder Bay Terminals	0.5	1.5	6.5	16.9	4.4	3.1	3.9	6.4	9.4	6.8	1.4	1.6	5.2
6[a]	Thunder Bay Terminals	1.1	3.3	11.9	18.1	4.6	3.1	5.5	6.7	7.3	5.3	1.9	5.1	6.2
7[a]	Thunder Bay Terminals	0.7	1.1	5.5	16.0	2.9	1.0	1.8	11.5	6.7	10.3	1.4	1.7	5.1

[a]Sites on company property.
[b]Values exceeding maximum acceptable levels of 7.0 (monthly) or 4.6 (annual mean) are underlined.

TABLE 2. Average annual dustfall ($g/m^2/30$ d) near Thunder Bay Terminals Limited, 1976-1990.

Monitoring site	Location	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	Sewage Treatment Plant	3.2	4.4	3.2	2.8	2.5	2.1	2.8	3.4	3.6	6.1[b]	1.8	2.7	3.5	2.8	5.0
3[a]	Thunder Bay Terminals	4.2	4.2	2.7	2.7	5.2	3.6	4.7	8.2	5.0	8.1	3.6	3.9	4.3	4.3	5.2
6[a]	Thunder Bay Terminals					8.5	6.9	8.8	19.5	15.3	15.7	3.5	5.1	4.7	4.9	6.2
7[a]	Thunder Bay Terminals					7.9	4.3	3.2	16.1	4.0	7.2	2.3	3.2	3.3	2.6	5.1
	Averages					6.0	4.2	4.9	11.8	7.0	9.3	2.8	3.7	4.0	3.6	5.4

[a]Sites on company property.
[b]Values above maximum acceptable level of 4.6 are underlined.

TABLE 3. Concentrations of total suspended particulate matter ($\mu g/m^3$) near Thunder Bay Terminals Limited, 1989.

Date	Monitoring Sites[a] 1	3[b]	10	Date	Monitoring Sites[a] 1	3[b]	10
Jan 5	14	18	15	Jul 4	67	72	41
11	19	15	12	10	56	63	31
17	20	21	18	16	34	55	42
23	38	37	25	22	41	65	21
29	31	40	66	28	61	69	38
Feb 4	76	58	46	Aug 3	78	85	61
10	39	30	31	9	84	89	53
16	31	40	19	15	64	84	32
22	35	47	42	21	77	95	50
28	44	45	43	27	36	50	29
Mar 6	54	68	72	Sep 2	33	49	21
12	20	28	-	8	18	84	34
18	25	35	37	14	14	21	31
24	26	56	38	20	19	32	19
30	72	90	93	26	27	88	45
Apr 5	34	37	35	Oct 2	35	66	31
11	70	94	35	8	26	56	18
17	60	81	29	14	24	31	19
23	36	56	74	20	46	65	24
29	47	68	19	26	100	64	49
May 5	46	78	40	Nov 1	85	99	54
11	49	54	41	7	53	68	33
17	18	20	17	13	32	48	29
23	56	40	-	19	59	53	41
29	55	77	-	25	10	49	18
Jun 4	50	72	-	Dec 1	-	-	-
10	84	58	44	7	26	20	23
16	15	56	27	13	12	13	16
22	45	65	35	19	16	18	38
28	22	47	25	25	20	20	20
				31	24	31	40
				Annual means:	32	36	48

[a]See Figure 1.
[b]Site on company property.
-Invalid data.

TABLE 4. Annual geometric means ($\mu g/m^3$) of total suspended particulate matter near Thunder Bay Terminals Limited, 1976-1990.

Year	Sewage Treatment Plant (Site 1[a])	Thunder Bay Terminals (Site 3[a])	McKellar Hospital (Site 10[a])
1976	41	47	49
1977	31	33	36
1978	27	34	44
1979	30	33	51
1980	28	33	44
1981	31	39	52
1982	28	32	39
1983	27	42	36
1984	38	59	44
1985	28	37	36
1986	34	49	40
1987	30	46	36
1988	34	50	37
1989	29	43	36
1990	32	36	48

[a]See Figure 1 for site locations.

TABLE 5. Concentrations of selected parameters in snow meltwater from samples collected in 1990 and 1991, near Thunder Bay Terminals Limited, Thunder Bay.

Sampling site[a]	Aluminum (µg/l)		Particulate carbon (mg/l)		Chloride (µg/l)		Iron (µg/l)		Potassium (µg/l)		Total Solids (mg/l)	
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
5[b]	2300[c]	650	350	60	3800	600	6300	1000	3800	180	690	120
6[b]	4200	1300	820	210	1200	800	10000	2100	960	250	2600	440
7[b]	3400	260	6	12	1000	1900	4200	460	480	260	250	40
8[b]	390	140	11	4	7200	800	860	250	390	400	60	25
9	420	160	14	13	900	500	660	220	300	160	60	40
10	380	110	8	3	1300	600	840	190	380	170	50	15
13	680	140	67	10	1000	400	1100	180	520	190	140	30
14[b]	2200	940	680	120	1300	800	5700	1900	930	220	1400	300
15[b]	1100	250	181	23	900	800	2200	450	480	310	410	60
16[b]	370	870	18	89	1000	1900	720	1500	450	580	65	200
17	480	97	13	3	1000	700	1100	170	370	230	110	9
18	390	110	56	6	800	400	630	150	440	130	140	25
19	650	350	86	45	1600	1200	1400	680	670	360	170	95
20	790	200	120	22	1300	800	1700	310	540	340	250	55
21	820	240	200	28	1000	900	1600	350	410	290	490	65
22	560	170	32	19	1200	600	720	250	370	230	100	60
23	1000	120	162	7	800	800	1300	160	350	350	340	25
24	340	100	38	12	400	900	530	160	230	220	85	30
25	580	77	150	8	1100	600	1000	97	450	340	250	25
26	700	120	98	8	1000	600	1200	160	650	320	210	30
27	660	74	67	5	900	500	950	110	330	300	130	25
28	500	93	49	7	500	600	690	120	250	340	100	15
Controls	180	34	3	1	150	125	200	47	140	50	11	9
Guidelines	500		7		4000		700		1000		40	

[a]See Figure 2.
[b]Sites on Thunder Bay Terminals property.
[c]Values above contaminant guidelines are underlined.

TABLE 6. Comparison between concentrations (mg/l) of selected parameters in meltwater from snow sampling surveys conducted in 1975, 1976, 1979, 1980, 1990 and 1991 near Thunder Bay Terminals Limited, Thunder Bay.

	Aluminum						Carbon						Iron						Suspended Solids					
	75[a]	76[b]	79[c]	80[c]	90[d]	91	75	76	79	80	90	91	75	76	79	80	90	91	75	76	79	80	90	91
5[e]			44.5[f]	10.5	2.3	0.6			1100	100	360	60			35.5	15.5	6.3	1.0			2500	430	480	95
6[e]	0.4	0.1	37.5	48.5	4.2	1.3	2	2	930	1300	820	210	0.2	0.4	26.0	39.0	10.0	2.1	35		1700	4200	2100	350
7[e]				16.5	3.4	0.3				520	7	12				10.6	4.2	0.5				1200	210	30
8[e]	0.6	0.3	2.6	2.8	0.4	0.1	3	3	15	100	12	4	1.2	1.2	9.8	2.2	0.9	0.2	60		100	200	40	10
9			3.4	1.0	0.4	0.2			150	24	15	13			2.8	1.9	0.7	0.2			200	110	40	30
10			<0.5	0.6	0.4	0.1			7	8	9	3			1.2	2.0	0.8	0.2			15	42	35	9
13			<0.5	<1	0.7	0.1			15	16	69	10			1.3	3.0	1.1	0.2			32	85	120	20
14[e]				20.0	2.2	0.9				1300	680	120				17.0	5.7	1.9				2200	1100	230
15[e]				10.0	1.1	0.2				160	180	23				9.6	2.2	0.4				670	310	45
16[e]				1.4	0.4	0.9				62	19	45				1.9	0.7	1.5				70	55	170
17[e]				2.1	0.5	0.1				35	14	3				5.0	1.1	0.2				110	45	8
Controls	0.2	0.1	<0.5	<1	0.2	<0.1	1	<1	3	4	4	1	0.1	0.2	0.4	<1	0.2	<0.1	30		7	18	10	9
Guidelines			0.5						10						0.7						25			

[a]Average of values from two surveys (January, March). Fixed depth sampling (20 cm).
[b]Fixed depth sampling (20 cm). Single samples.
[c]Complete profile sampled. Duplicate samples for each site.
[d]Complete profile sampled. Single samples.
[e]Site on Thunder Bay Terminals property.
[f]Values above guidelines are underlined.